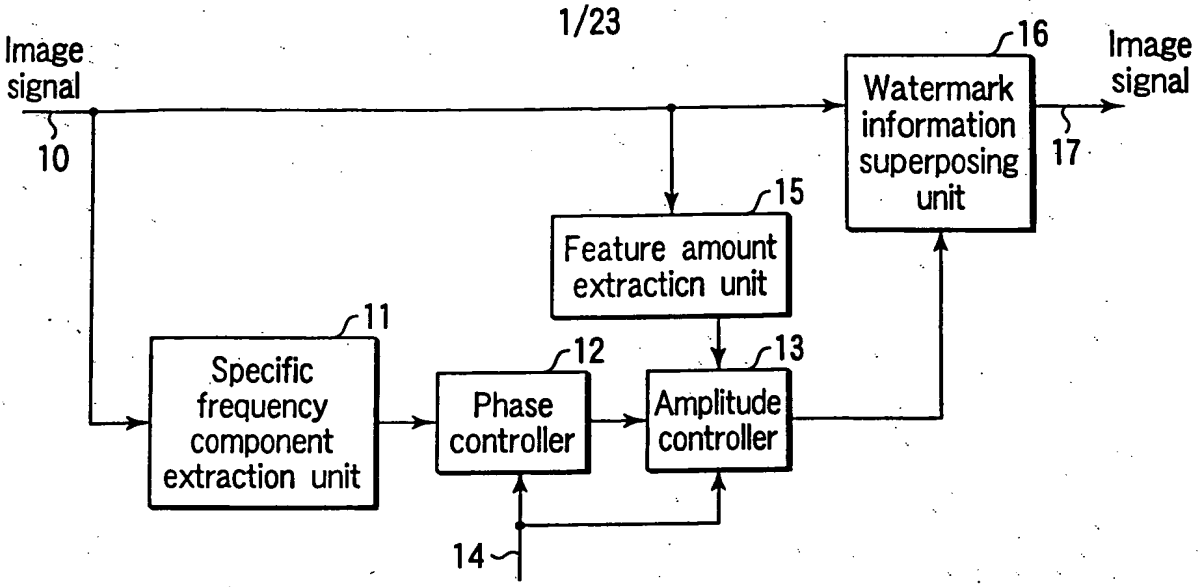


FIG. 1

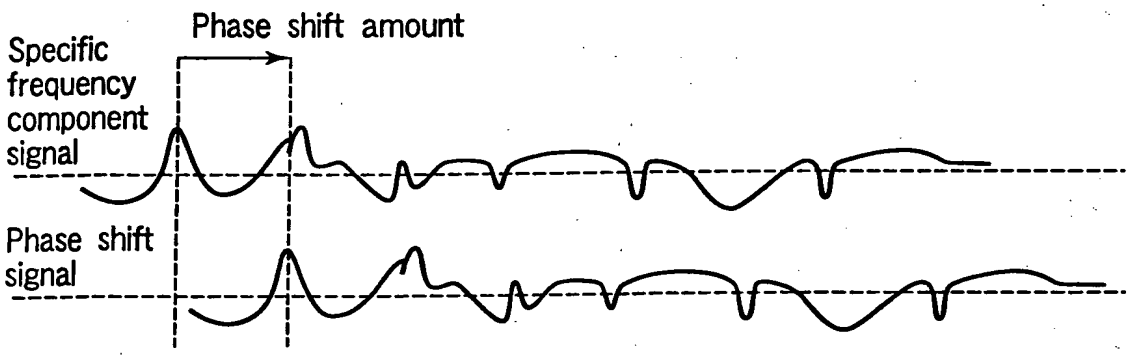


FIG. 2

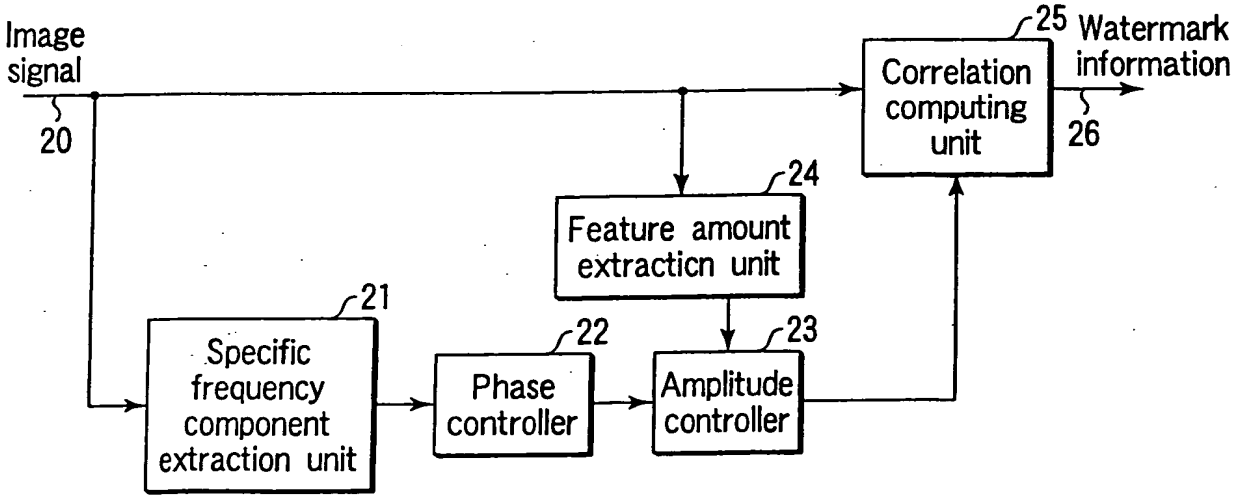


FIG. 3

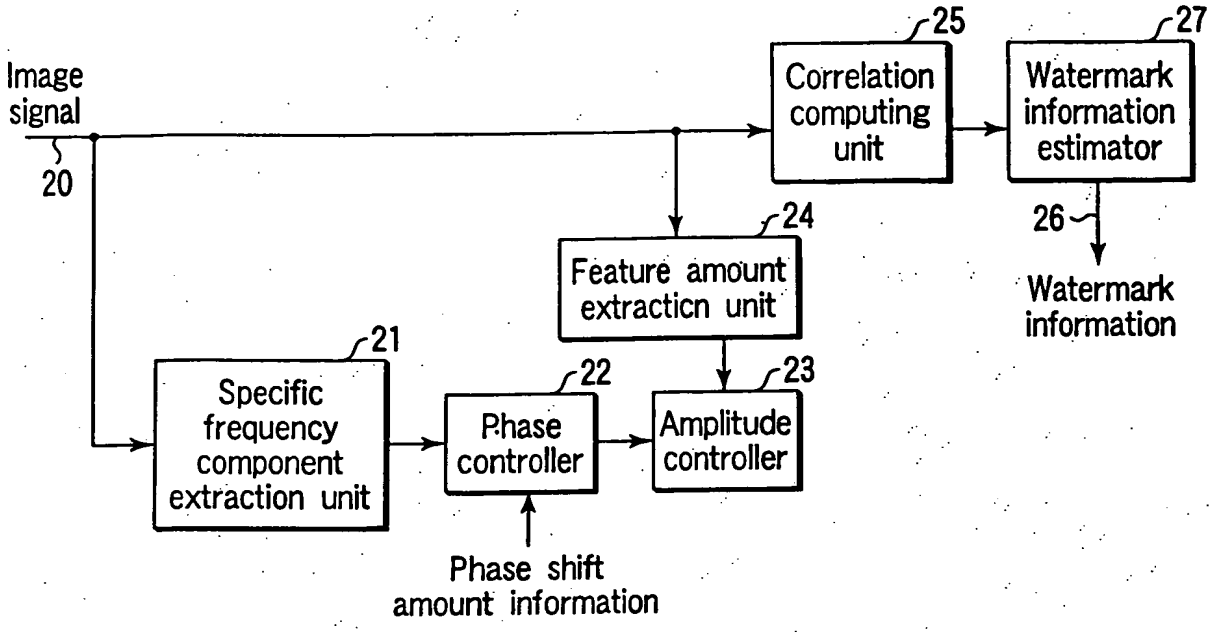

Image signal
20
Correlation computing unit
25
Watermark information estimator
27
26
Watermark information
Feature amount extraction unit
24
Specific frequency component extraction unit
21
Phase controller
22
Amplitude controller
23
Phase shift amount information

FIG. 4

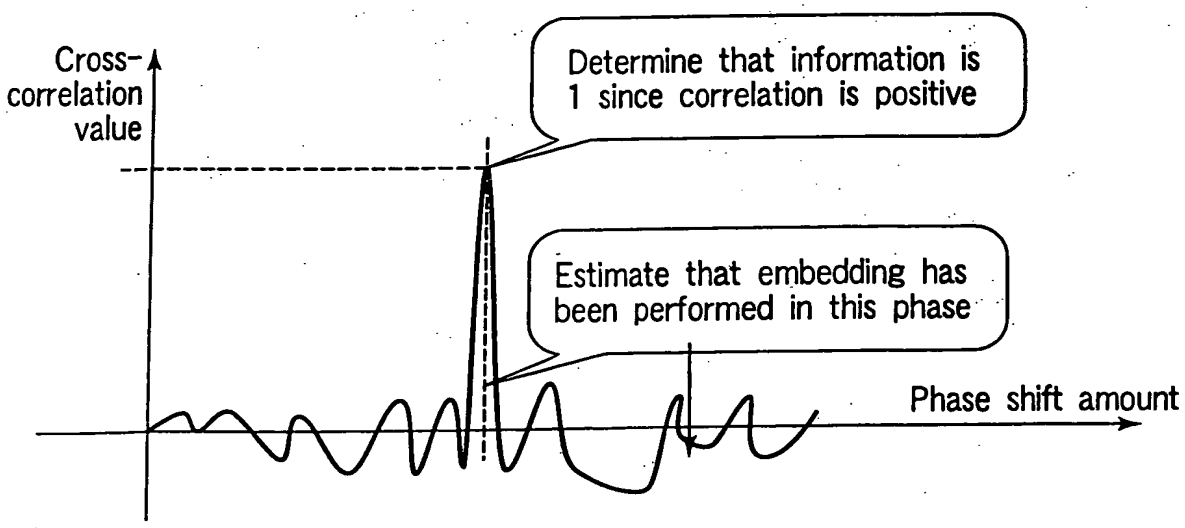

Cross-correlation value
Determine that information is 1 since correlation is positive
Estimate that embedding has been performed in this phase
Phase shift amount

FIG. 5

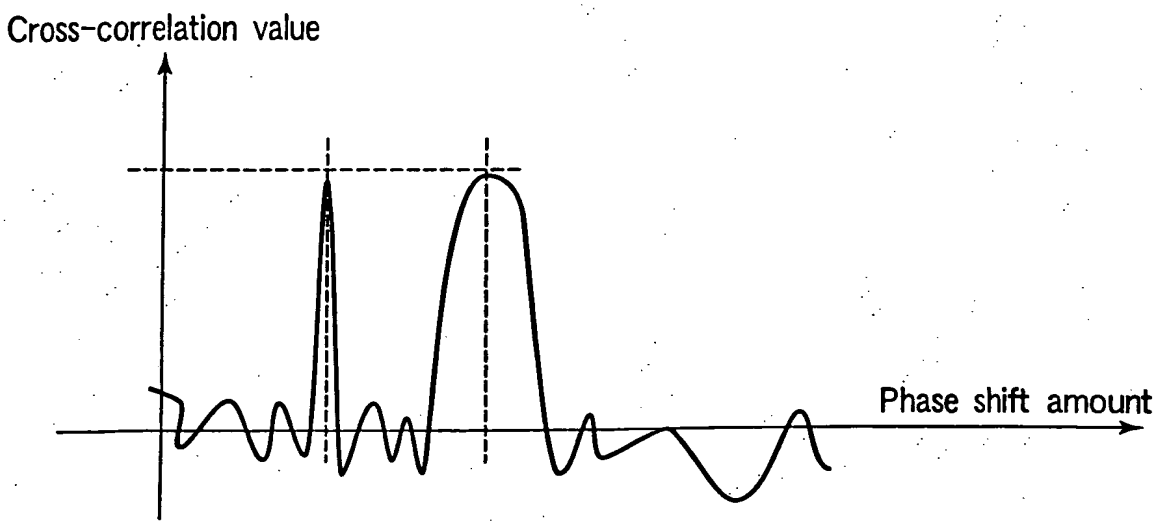

Cross-correlation value
Phase shift amount

FIG. 6

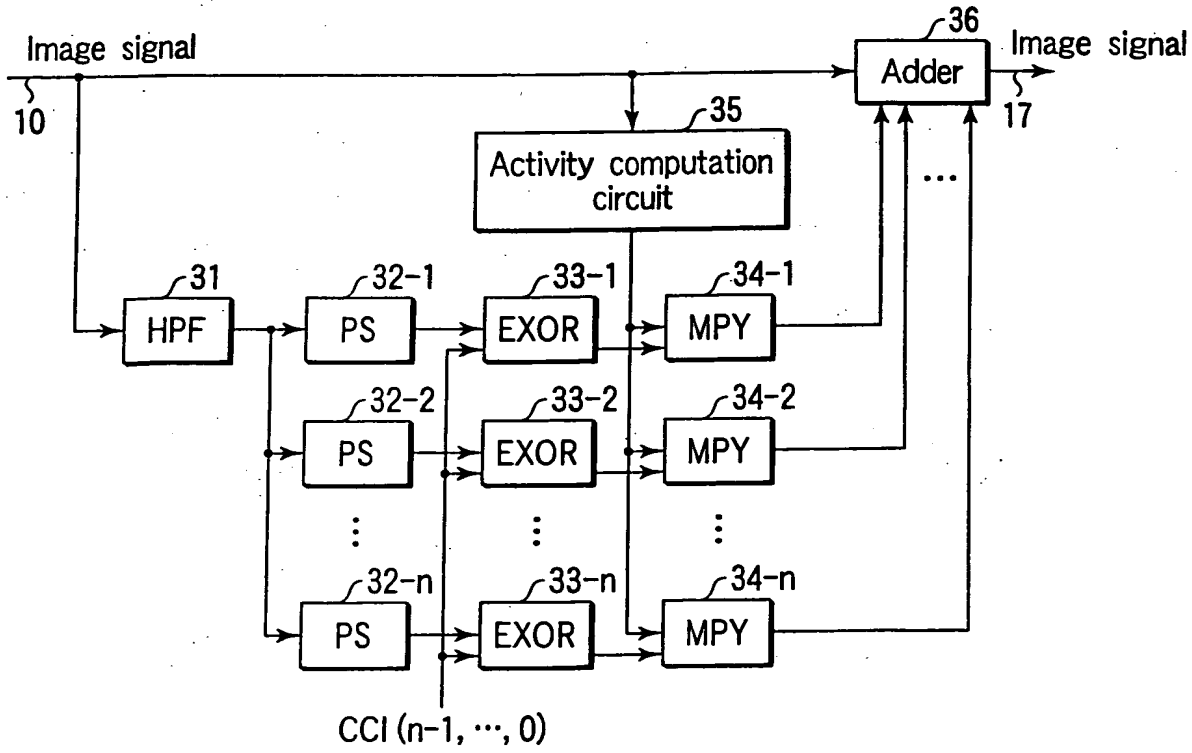

Image signal
10
36
Adder
Image signal
17
35
Activity computation circuit
31
HPF
32-1
PS
33-1
EXOR
34-1
MPY
32-2
PS
33-2
EXOR
34-2
MPY
32-n
PS
33-n
EXOR
34-n
MPY
CCI (n-1, ···, 0)

FIG. 7

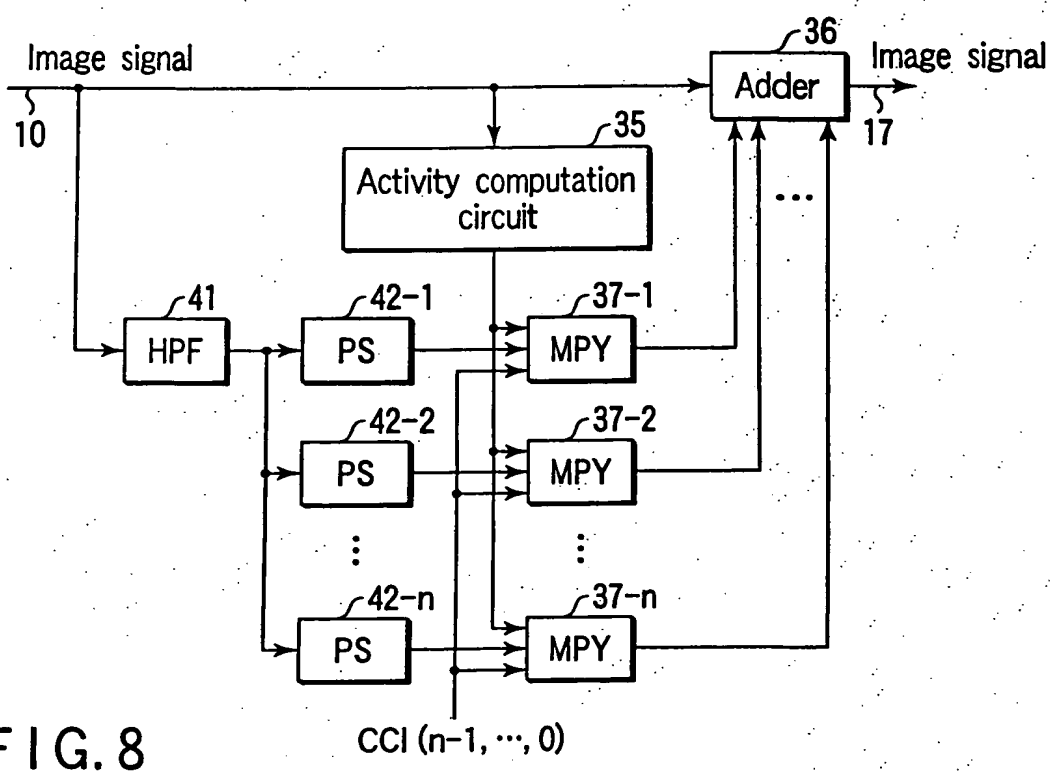

Image signal
10
36
Adder
Image signal
17
35
Activity computation circuit
41
HPF
42-1
PS
37-1
MPY
42-2
PS
37-2
MPY
42-n
PS
37-n
MPY
CCI (n-1, ···, 0)

FIG. 8

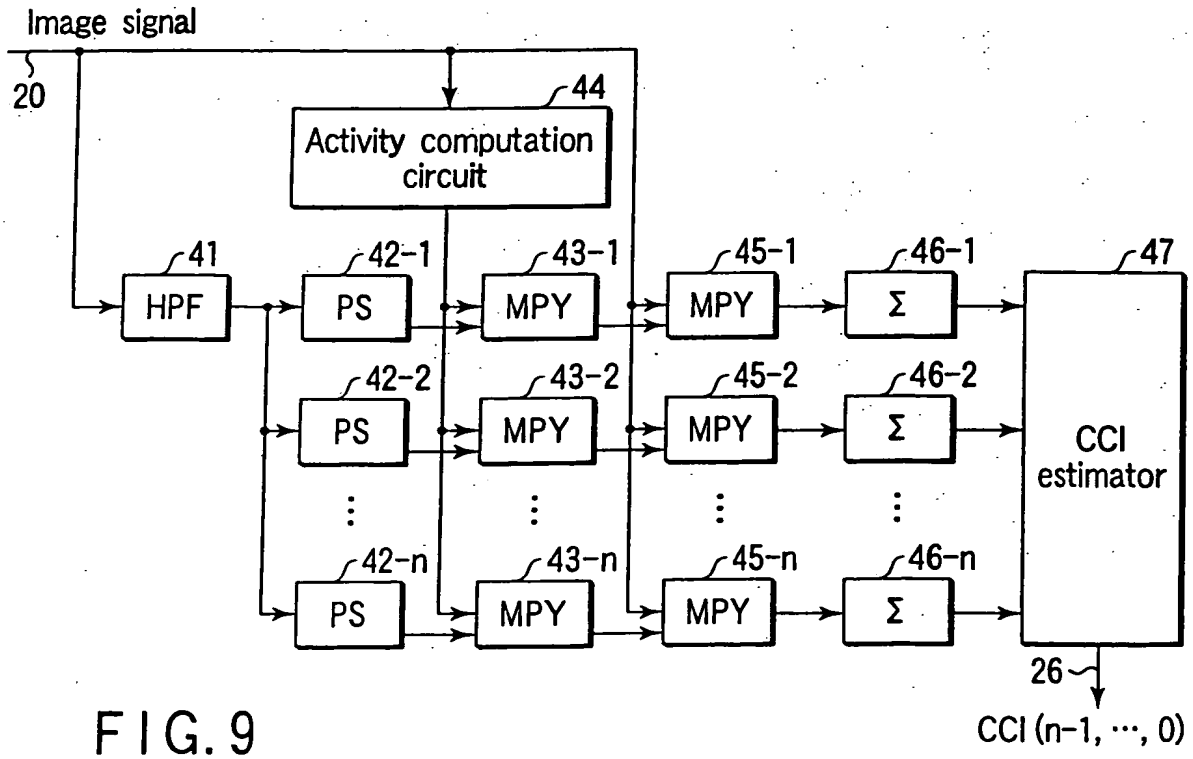

Image signal
20
44
Activity computation circuit
41
HPF
42-1
PS
43-1
MPY
45-1
MPY
46-1
Σ
47
42-2
PS
43-2
MPY
45-2
MPY
46-2
Σ
CCI estimator
42-n
PS
43-n
MPY
45-n
MPY
46-n
Σ
26
CCI (n-1, ···, 0)

FIG. 9

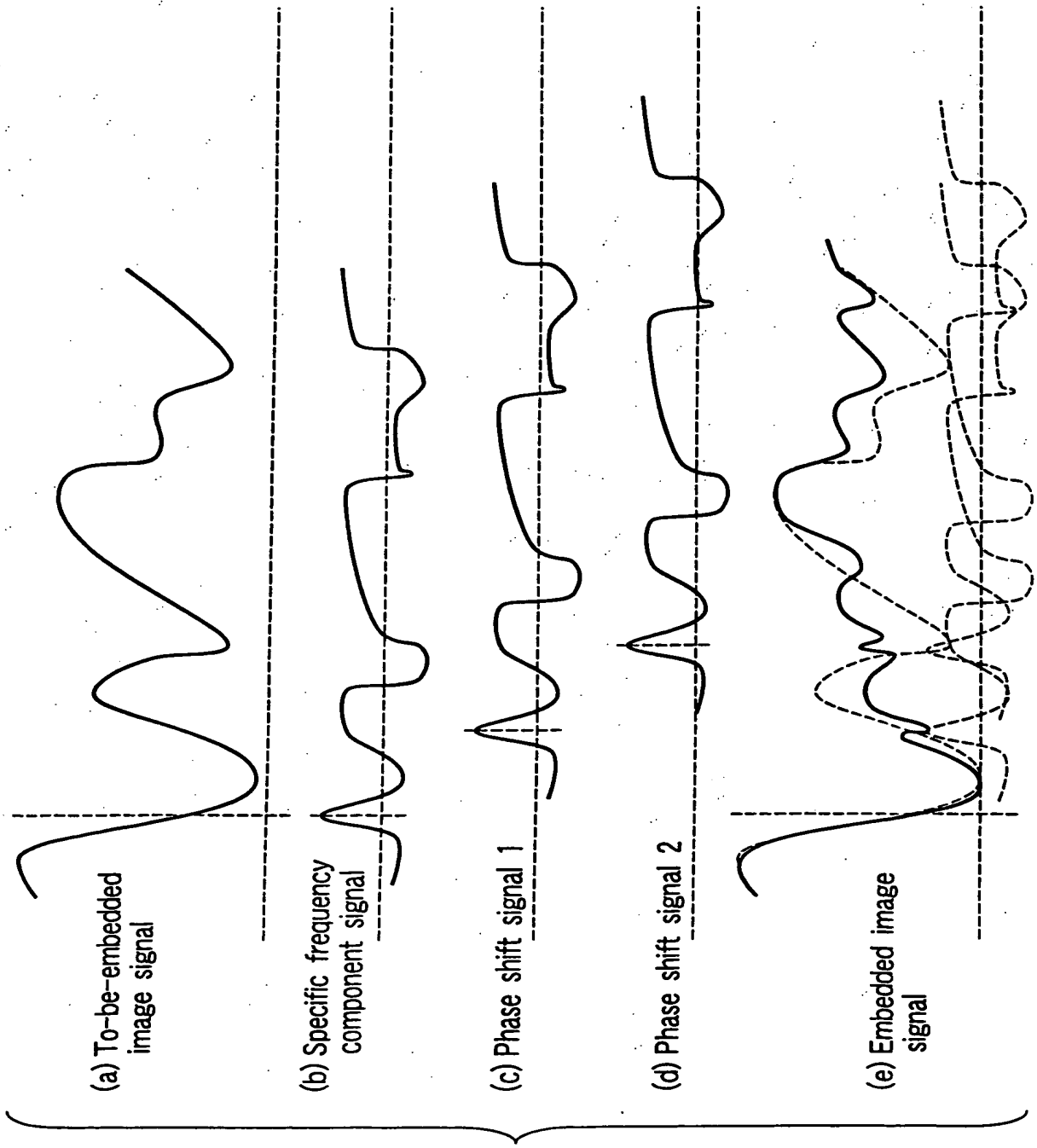

(a) To-be-embedded image signal
(b) Specific frequency component signal
(c) Phase shift signal 1
(d) Phase shift signal 2
(e) Embedded image signal

FIG. 10

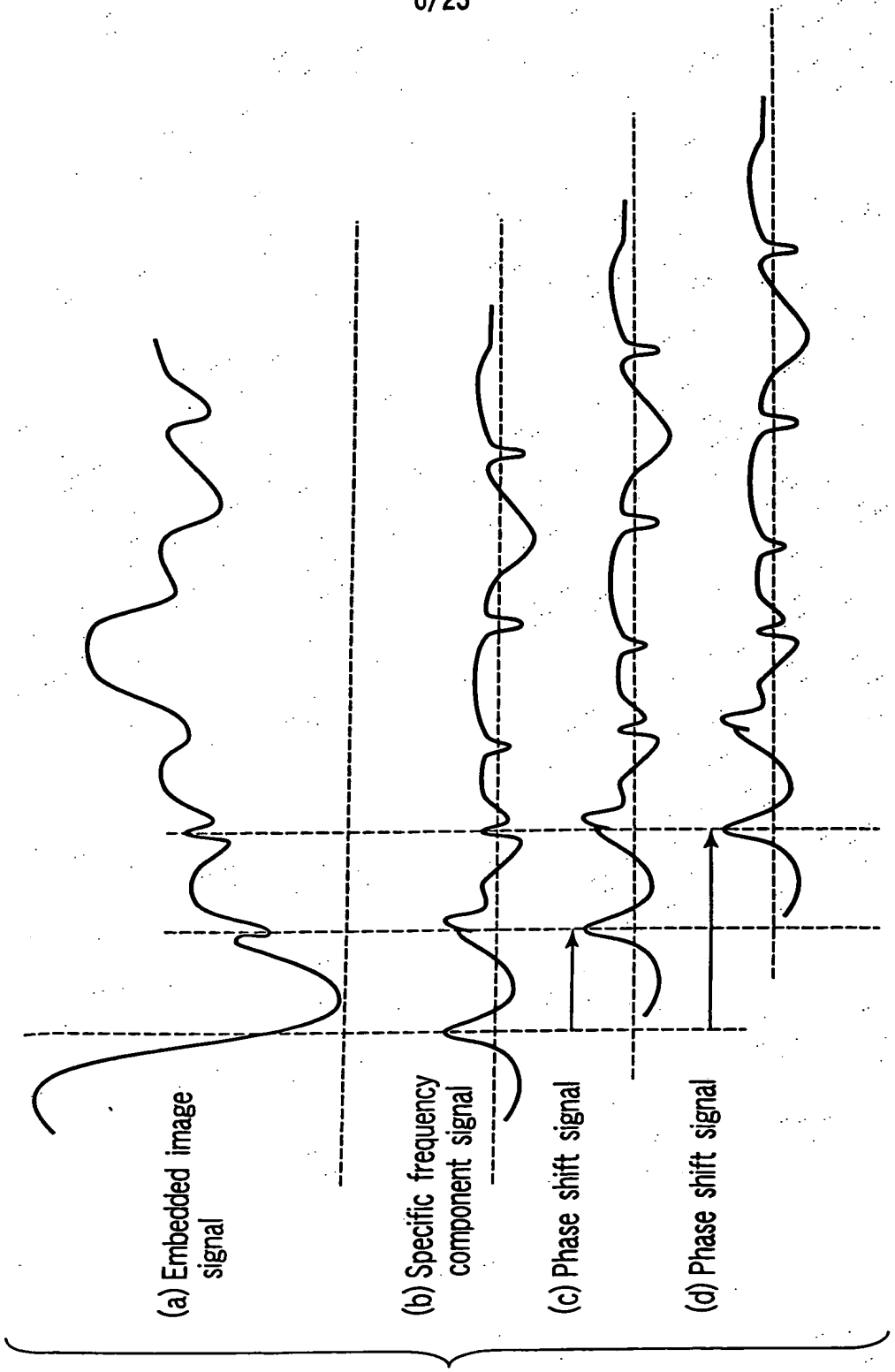

(a) Embedded image signal
(b) Specific frequency component signal
(c) Phase shift signal
(d) Phase shift signal

FIG. 11

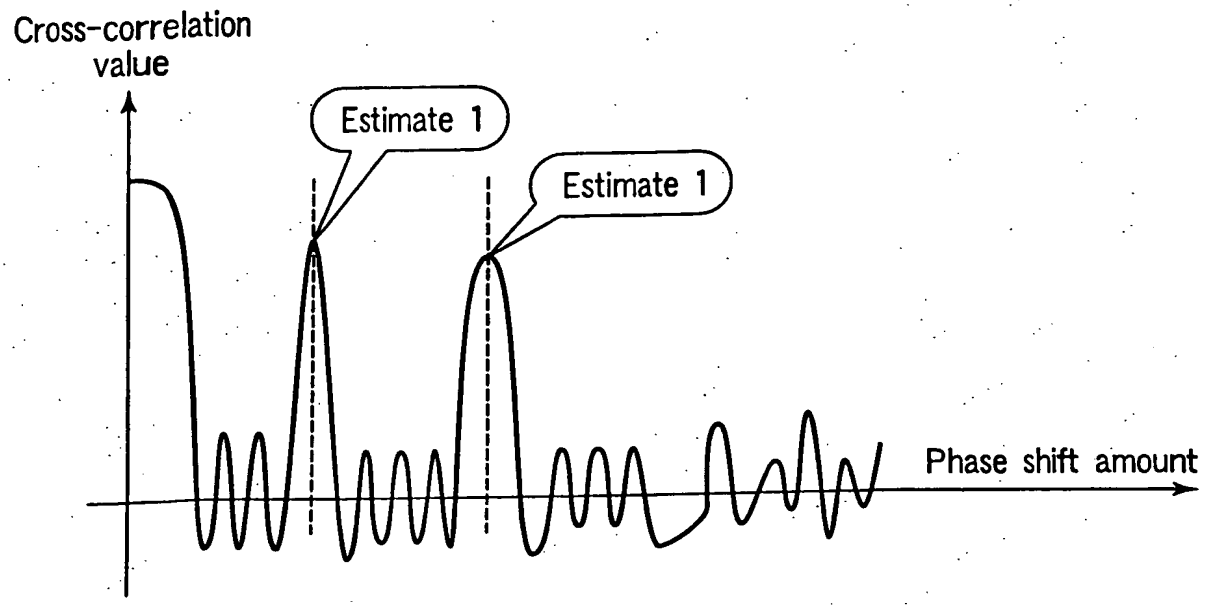

Cross-correlation value
Estimate 1
Estimate 1
Phase shift amount

FIG. 12

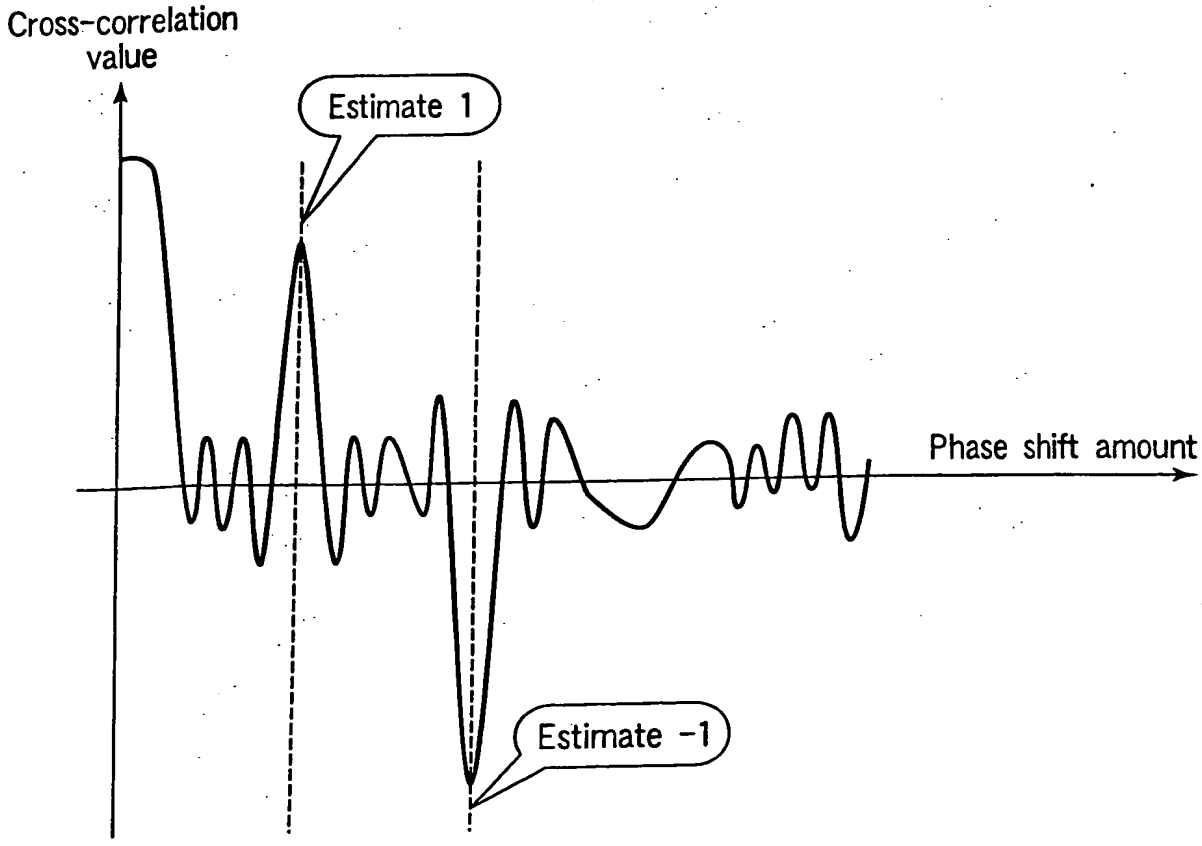

Cross-correlation value
Estimate 1
Phase shift amount
Estimate -1

FIG. 13

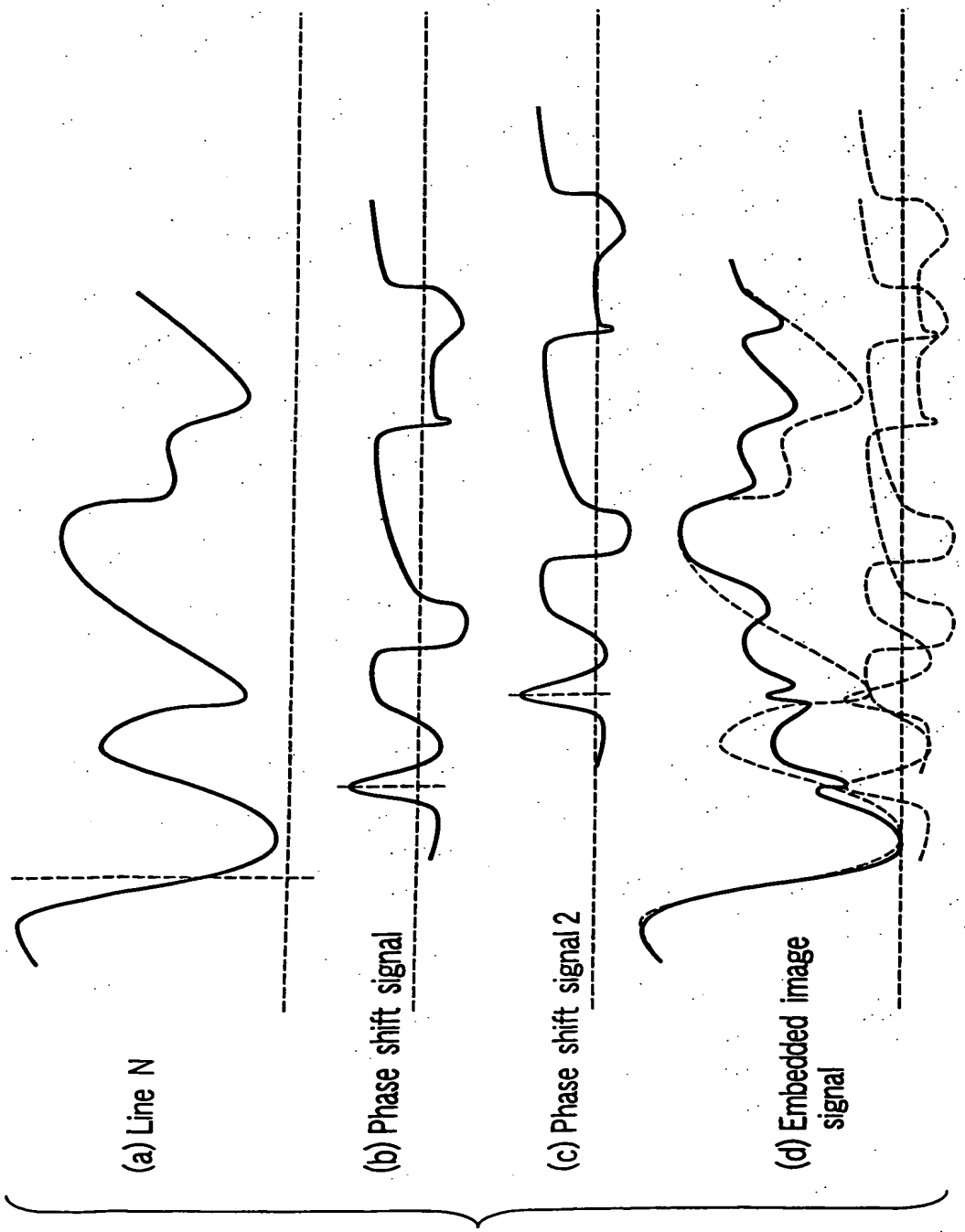

(a) Line N
(b) Phase shift signal
(c) Phase shift signal 2
(d) Embedded image signal

FIG. 14

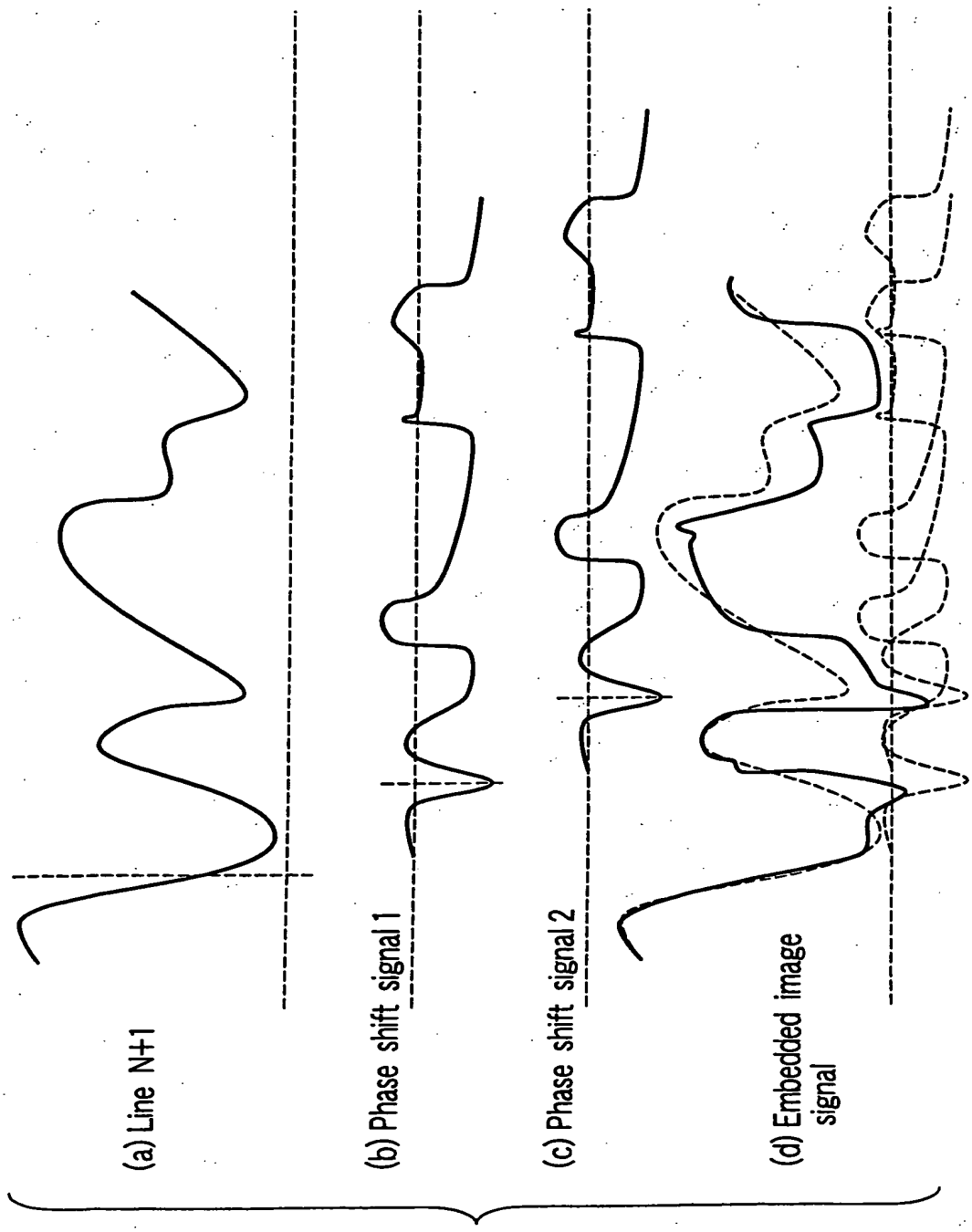

(a) Line N+1
(b) Phase shift signal 1
(c) Phase shift signal 2
(d) Embedded image signal

FIG. 15

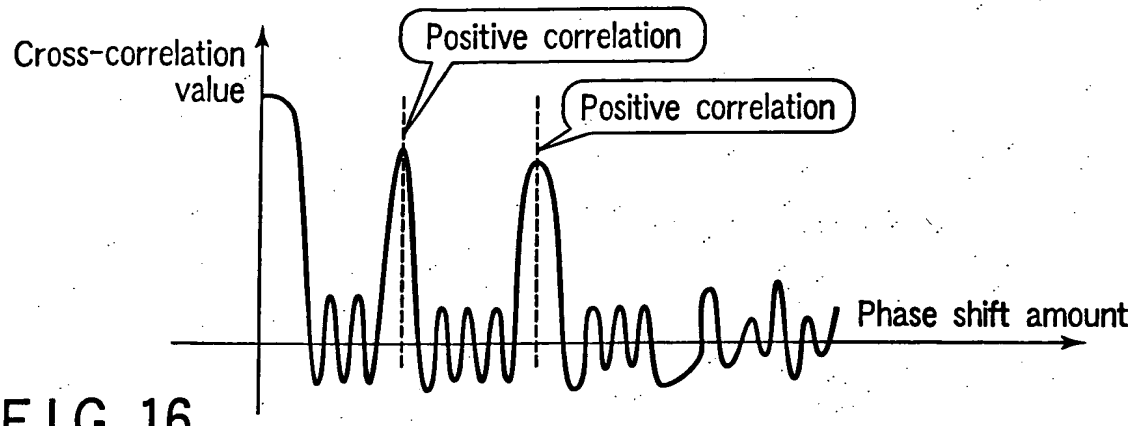


FIG. 16

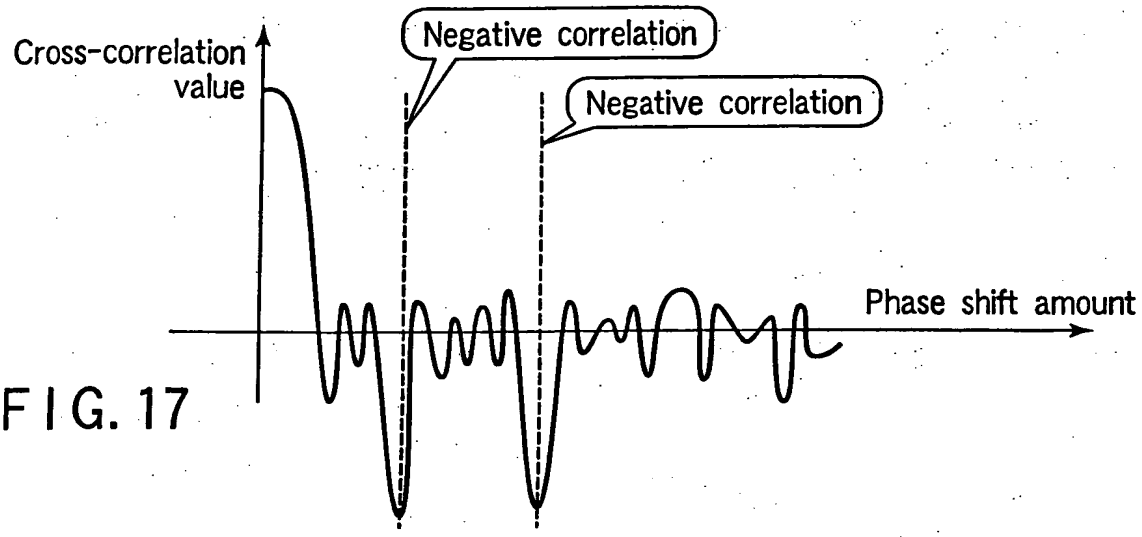


FIG. 17

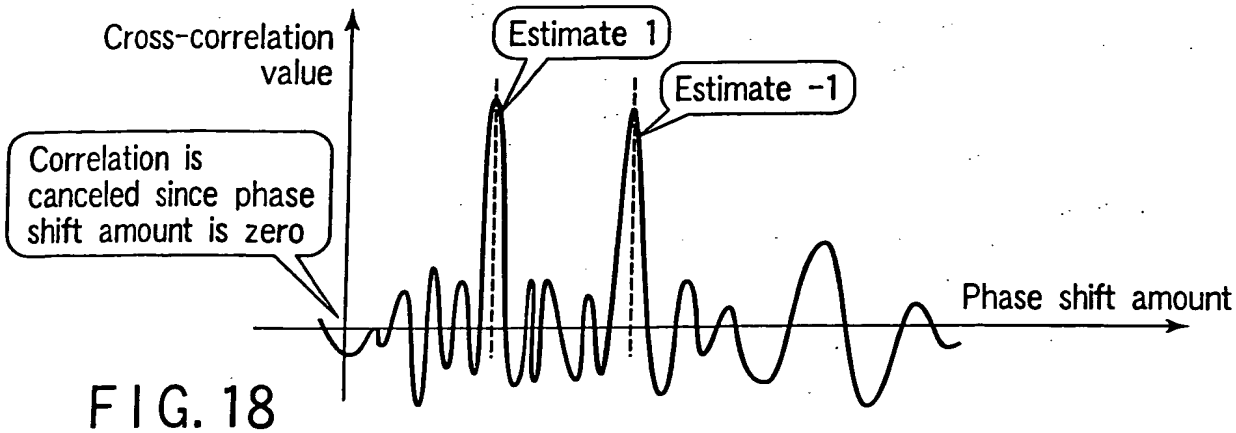


FIG. 18

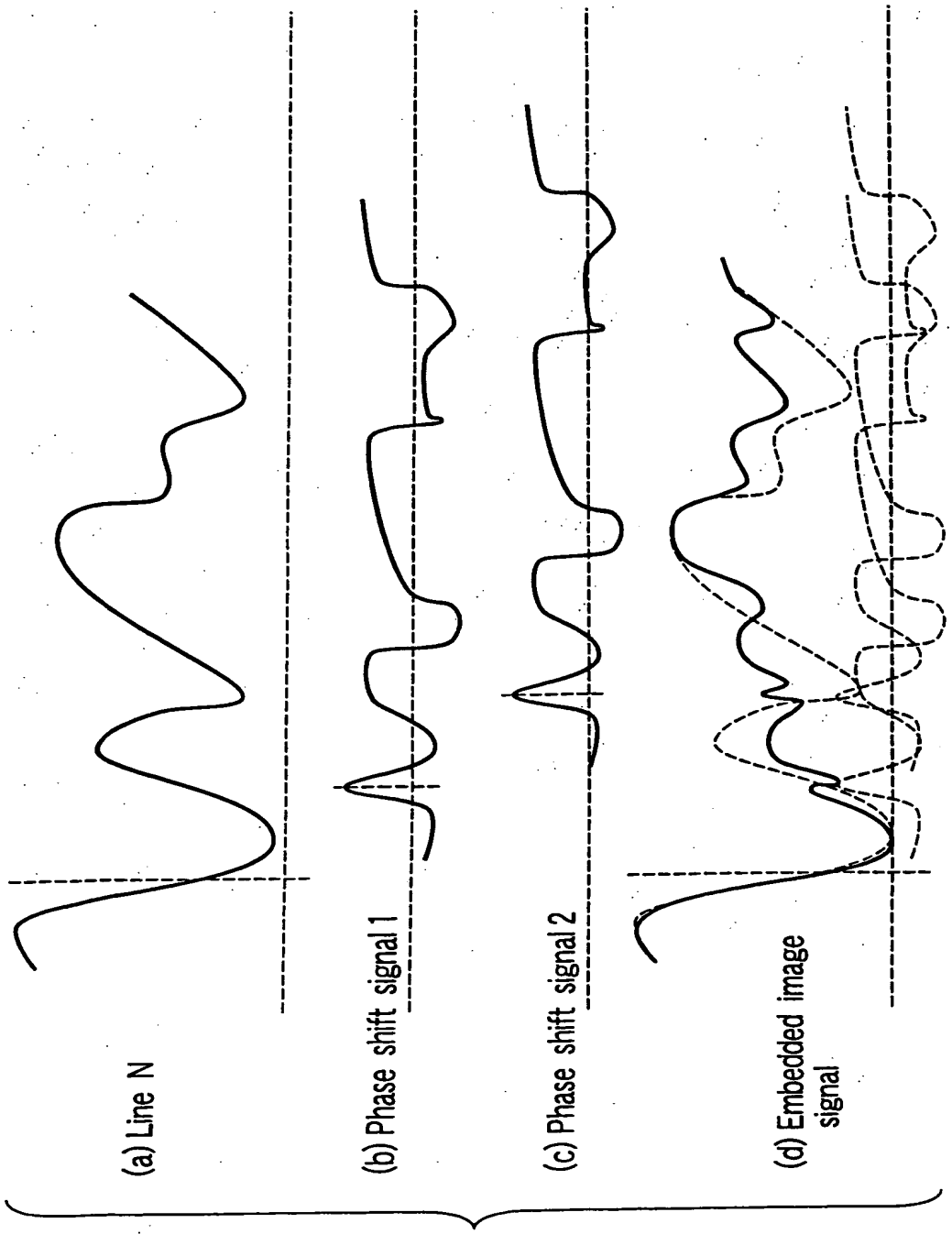

(a) Line N
(b) Phase shift signal 1
(c) Phase shift signal 2
(d) Embedded image signal

FIG. 19

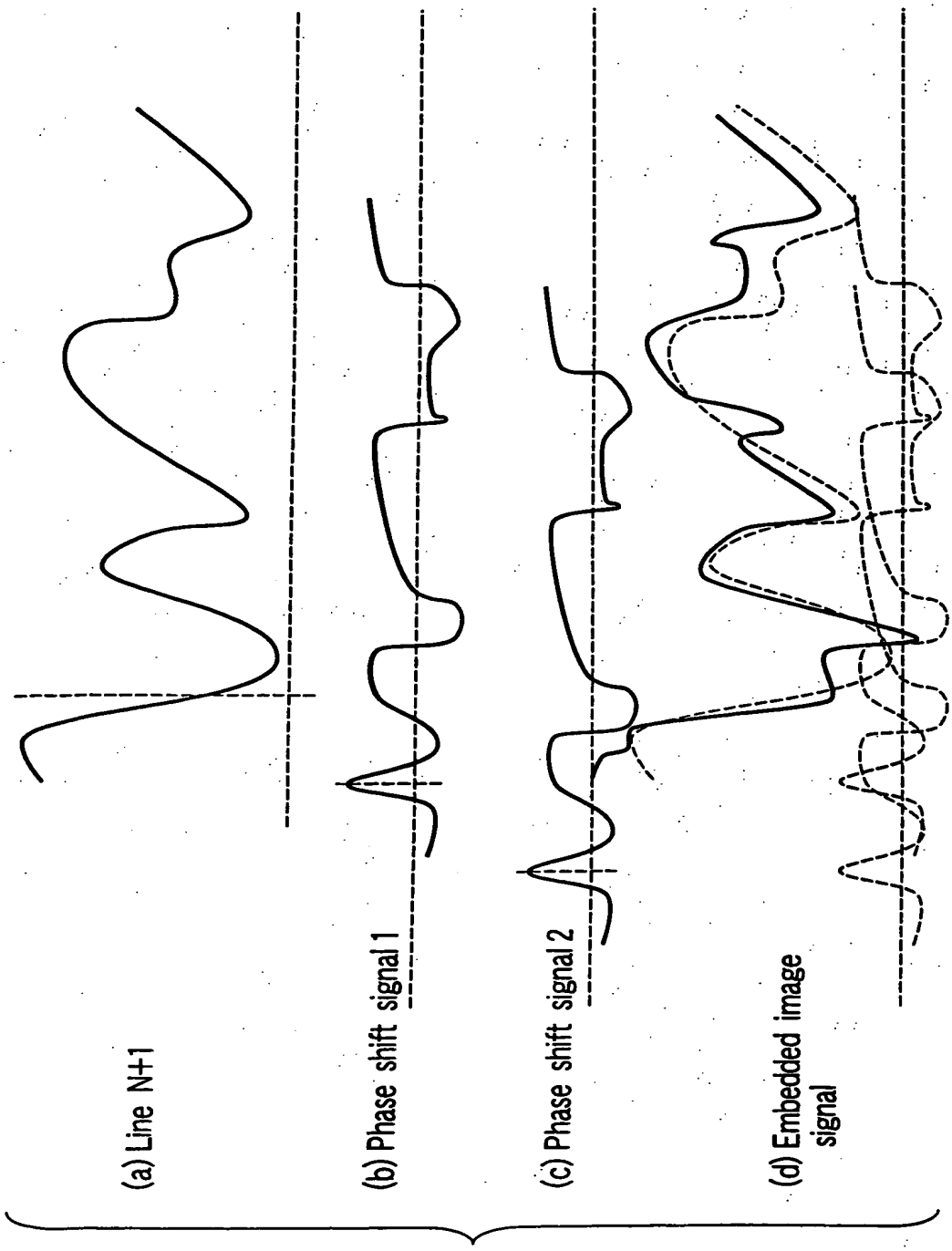

(a) Line N+1
(b) Phase shift signal 1
(c) Phase shift signal 2
(d) Embedded image signal

FIG. 20

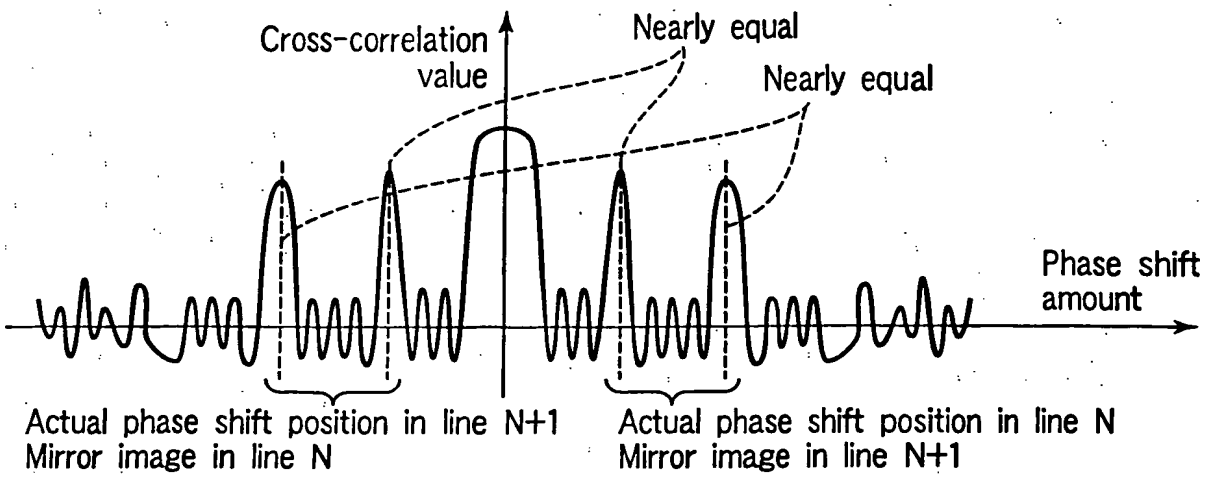

Cross-correlation value
Nearly equal
Nearly equal
Phase shift amount
Actual phase shift position in line N+1
Mirror image in line N
Actual phase shift position in line N
Mirror image in line N+1

FIG. 21

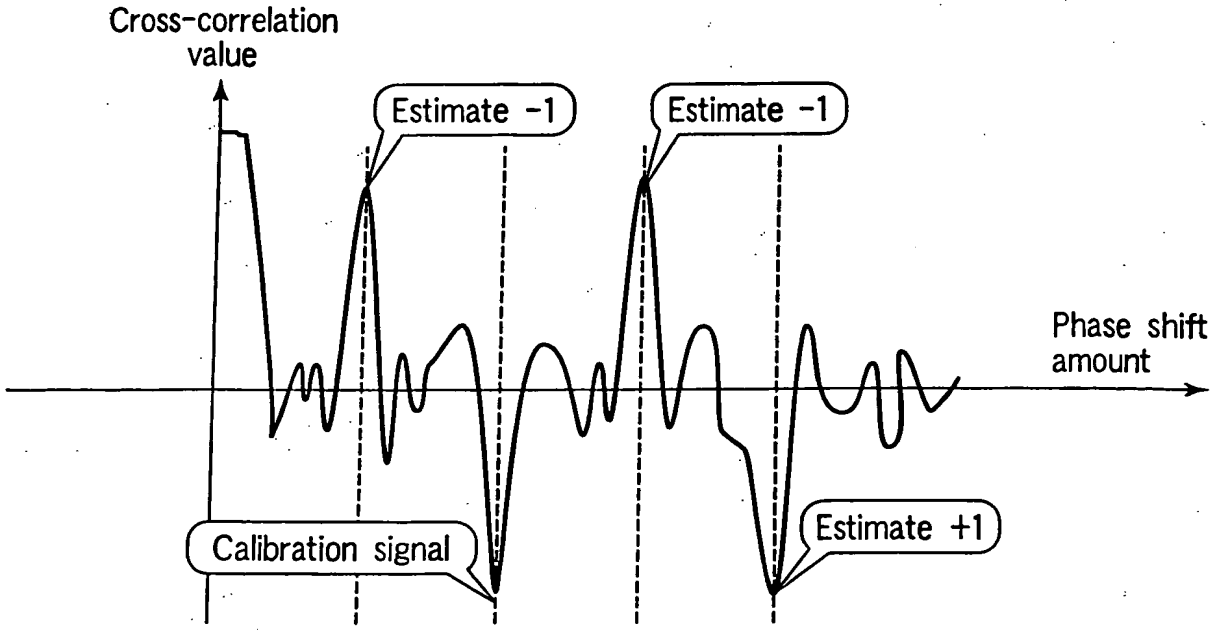

Cross-correlation value
Estimate -1
Estimate -1
Phase shift amount
Calibration signal
Estimate +1

FIG. 22

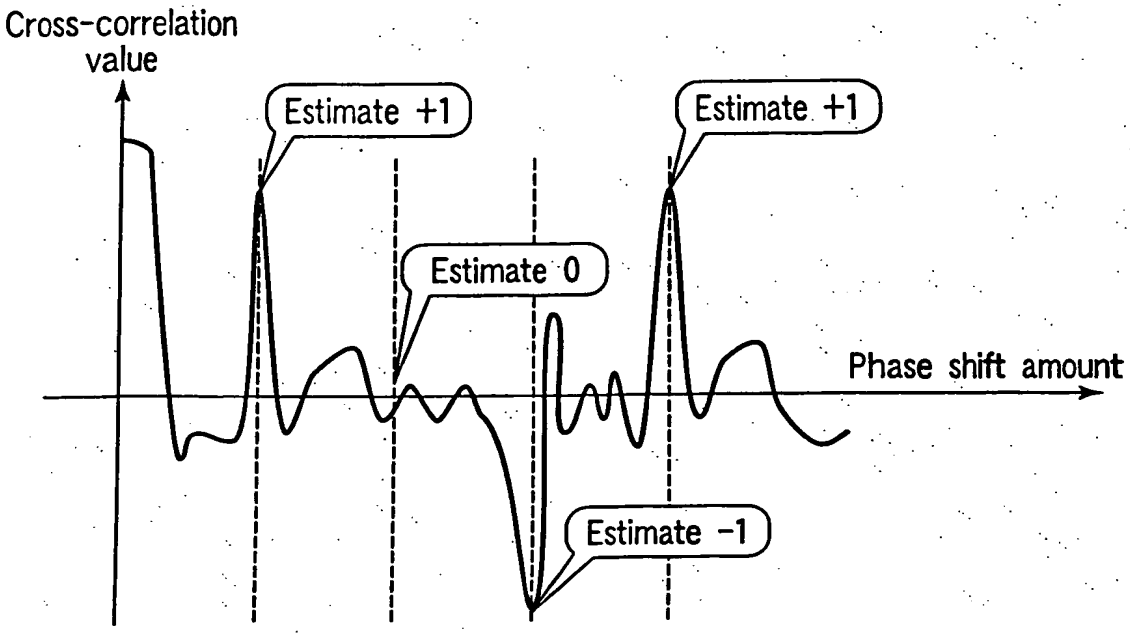


FIG. 23

-1	-1	0	0	0
-1	0	0	0	1
-1	+1	0	1	0
0	-1	0	1	1
0	0	1	0	0
0	+1	1	0	1
+1	-1	1	1	0
+1	0	1	1	1
+1	+1	Not used	Not used	Not used

FIG. 24

-1	-1	0	0	0
-1	0	0	0	1
-1	+1	0	1	0
0	-1	0	1	1
0	0	forbidden	forbidden	forbidden
0	+1	1	0	0
+1	-1	1	0	1
+1	0	1	1	0
+1	+1	1	1	1

FIG. 25

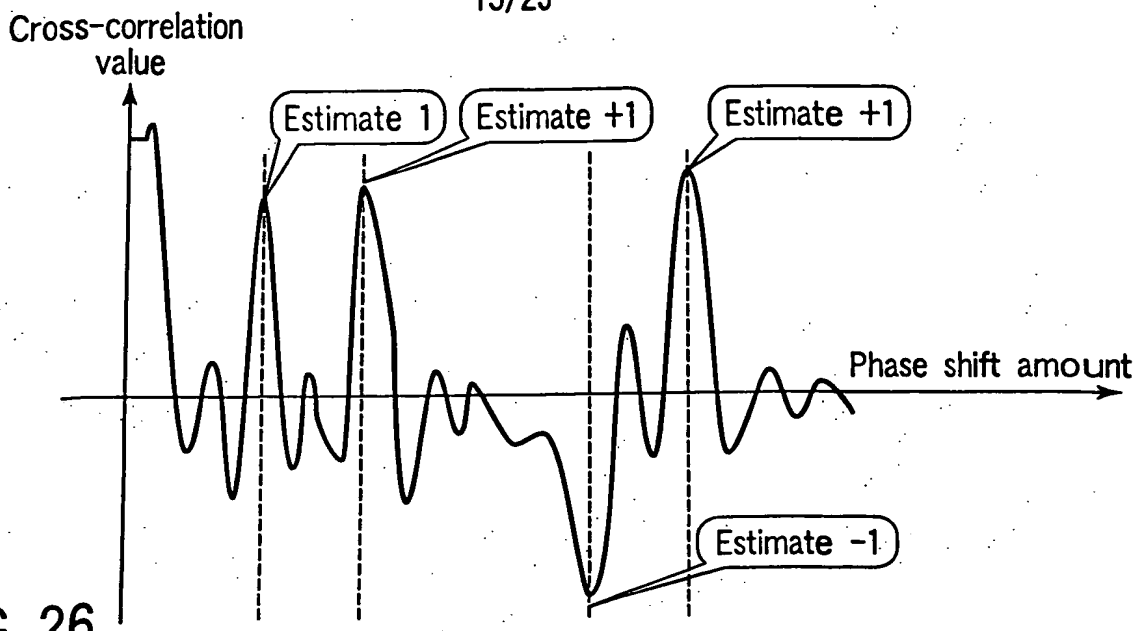


FIG. 26

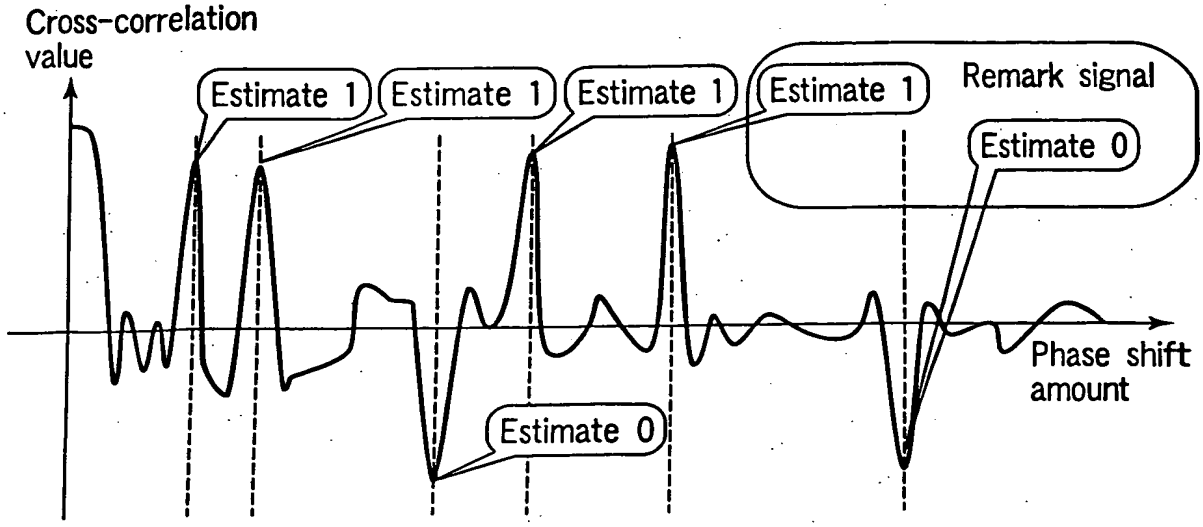


FIG. 27

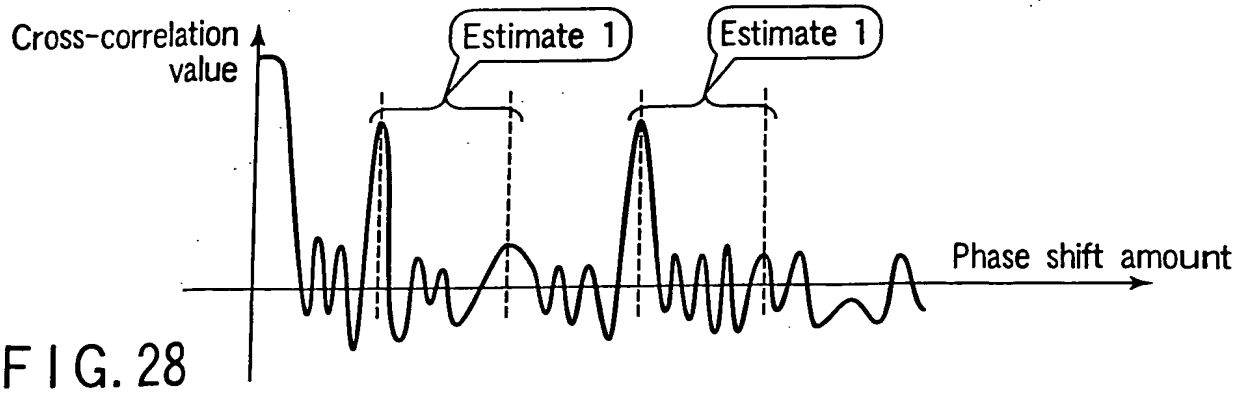


FIG. 28

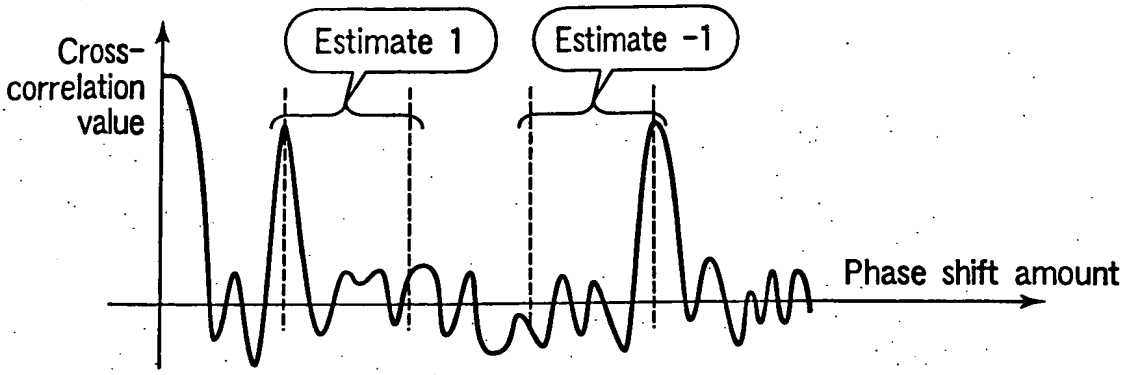

Cross-correlation value
Estimate 1
Estimate -1
Phase shift amount

FIG. 29

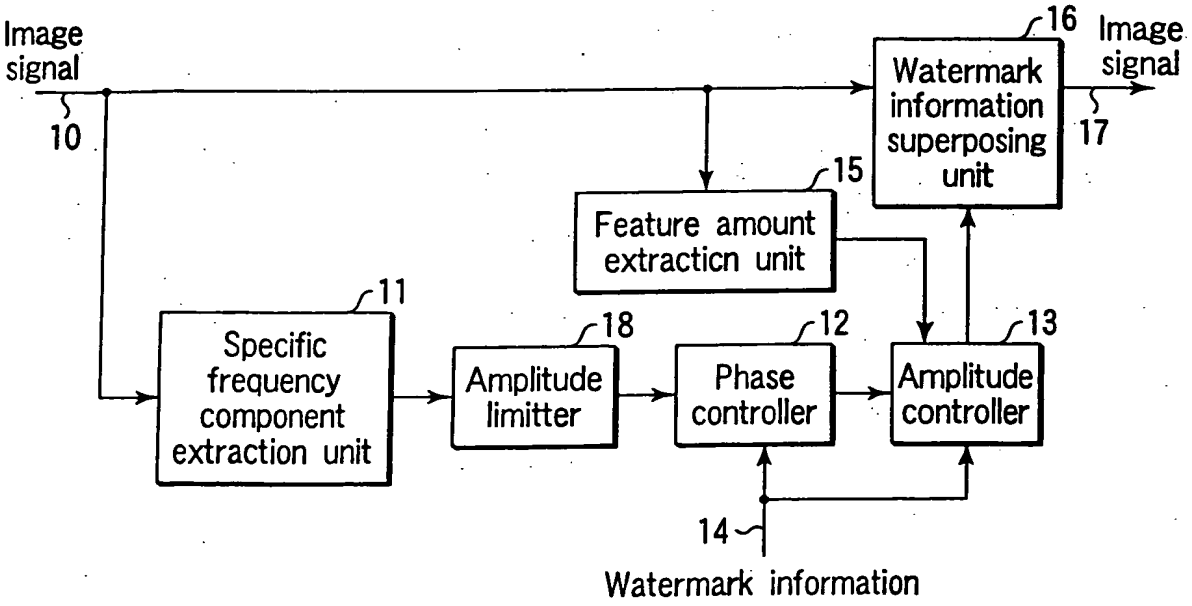

Image signal
10
16
Watermark information superposing unit
Image signal
17
15
Feature amount extraction unit
11
Specific frequency component extraction unit
18
Amplitude limitter
12
Phase controller
13
Amplitude controller
14
Watermark information

FIG. 30

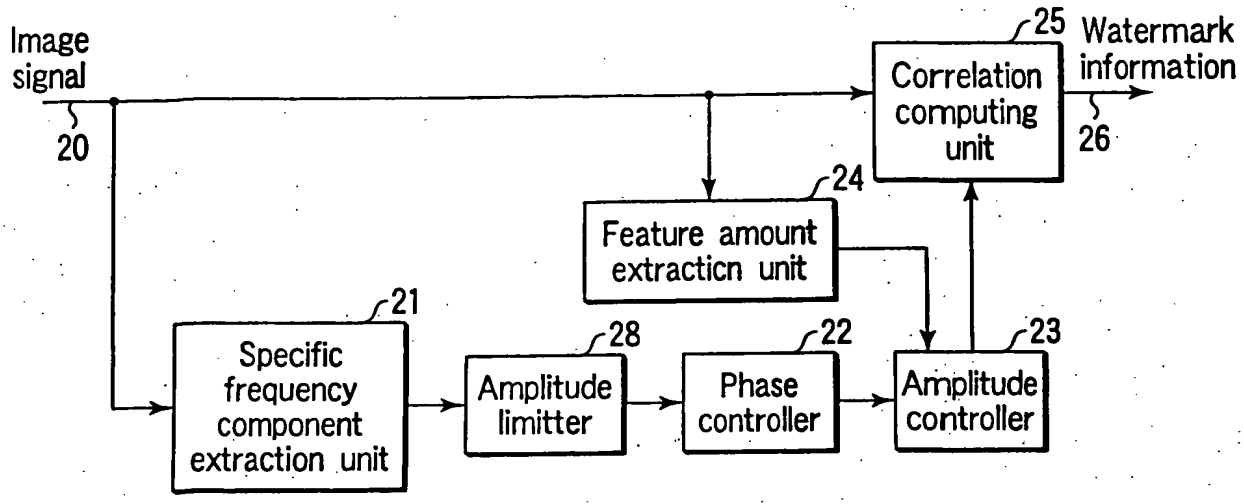

Image signal
20
25
Watermark information
Correlation computing unit
26
24
Feature amount extraction unit
21
Specific frequency component extraction unit
28
Amplitude limitter
22
Phase controller
23
Amplitude controller

FIG. 31

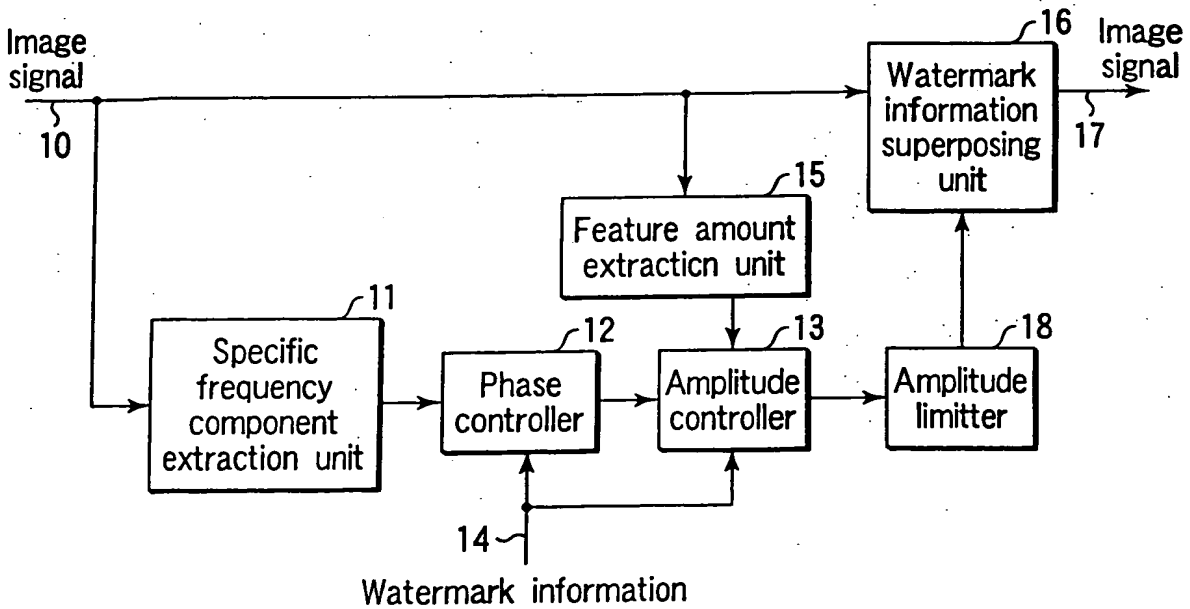

Image signal
10
16
Image signal
Watermark information superposing unit
17
15
Feature amount extraction unit
11
Specific frequency component extraction unit
12
Phase controller
13
Amplitude controller
18
Amplitude limitter
14
Watermark information

FIG. 32

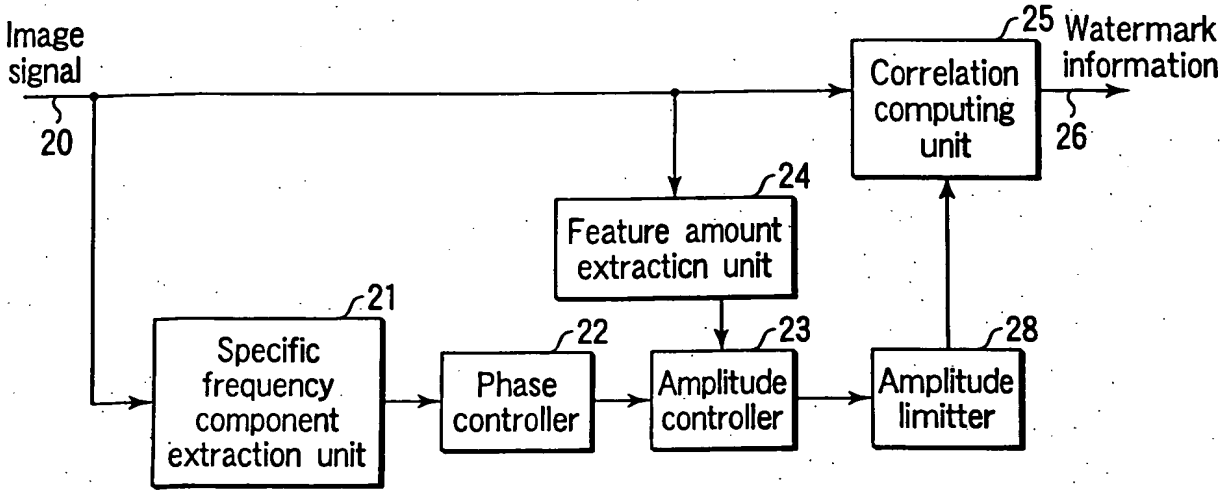

Image signal
20
25
Watermark information
Correlation computing unit
26
24
Feature amount extracticn unit
21
Specific frequency component extraction unit
22
Phase controller
23
Amplitude controller
28
Amplitude limitter

FIG. 33

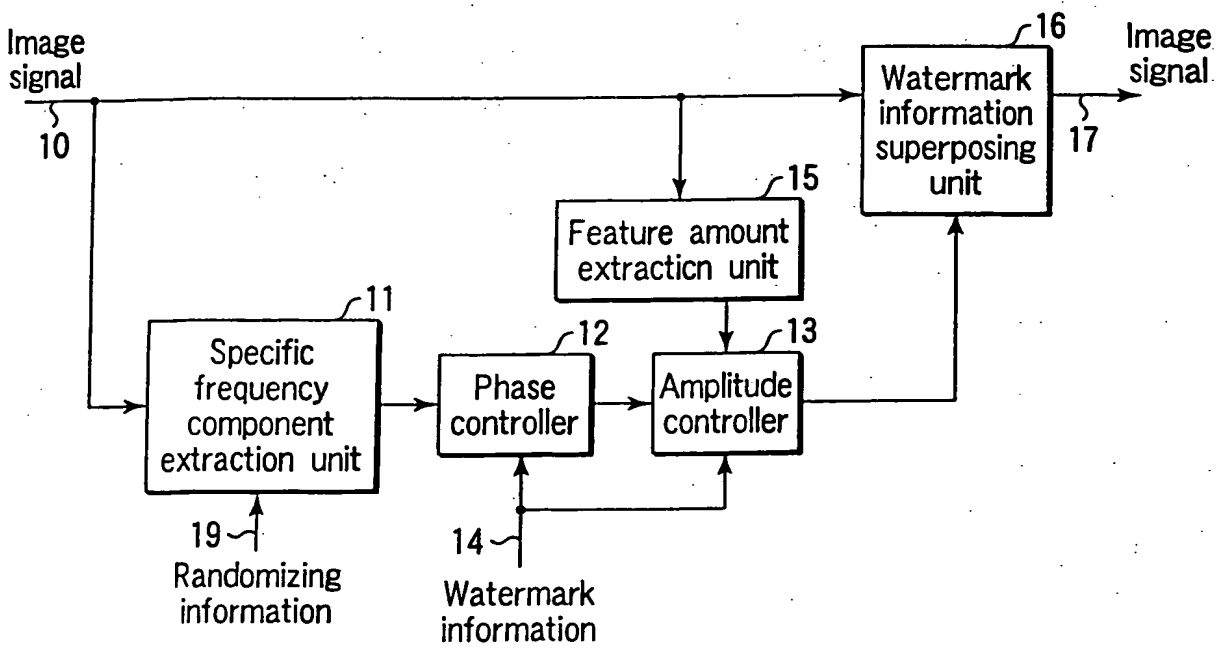

Image signal
10
16
Watermark information superposing unit
Image signal
17
15
Feature amount extracticn unit
11
Specific frequency component extraction unit
12
Phase controller
13
Amplitude controller
19
Randomizing information
14
Watermark information

FIG. 34

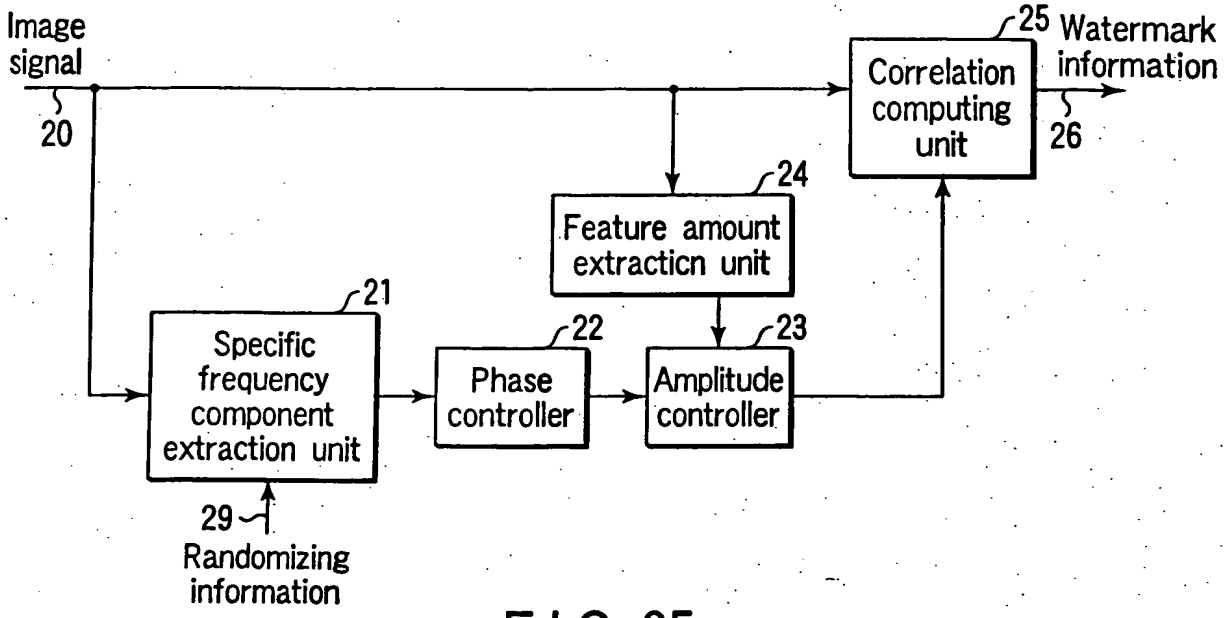

Image signal
20
25
Watermark information
Correlation computing unit
26
24
Feature amount extraction unit
21
Specific frequency component extraction unit
22
Phase controller
23
Amplitude controller
29
Randomizing information

FIG. 35

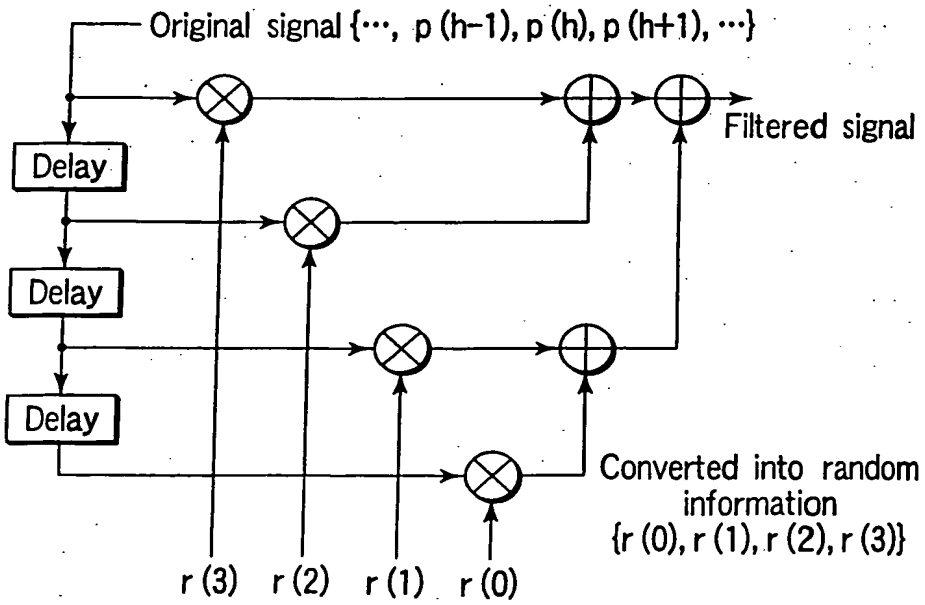

Original signal {···, p (h-1), p (h), p (h+1), ···}
Filtered signal
Delay
Delay
Delay
Converted into random information
{r (0), r (1), r (2), r (3)}
r (3)
r (2)
r (1)
r (0)

FIG. 36

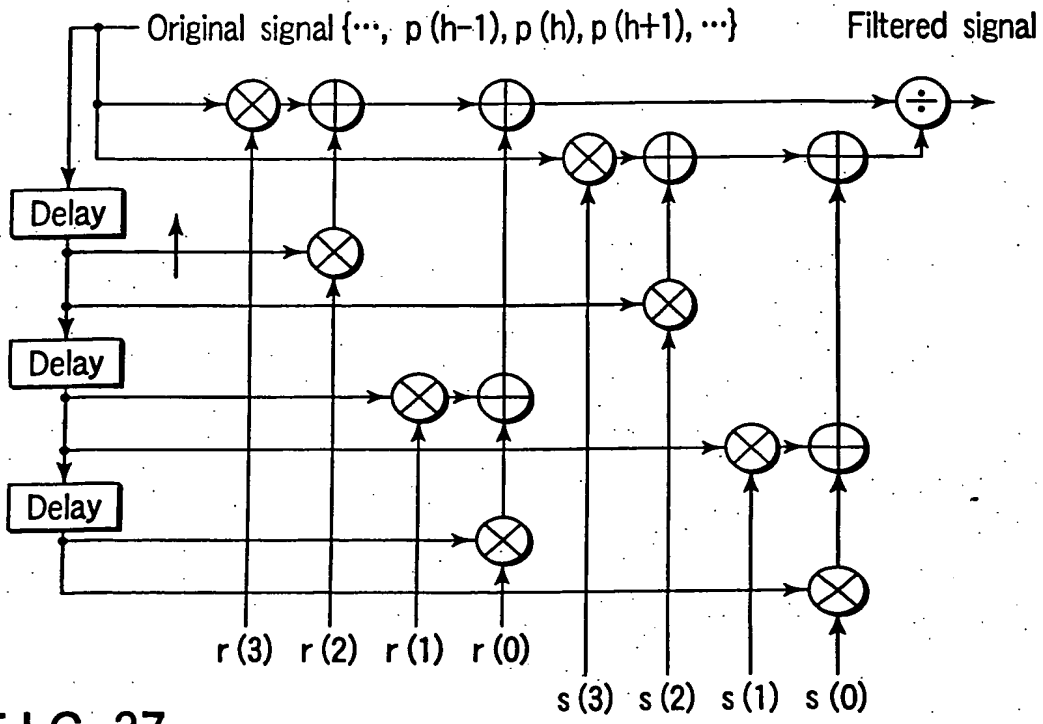

Original signal {···, p (h-1), p (h), p (h+1), ···}
Filtered signal
Delay
Delay
Delay
r (3)
r (2)
r (1)
r (0)
s (3)
s (2)
s (1)
s (0)

FIG. 37

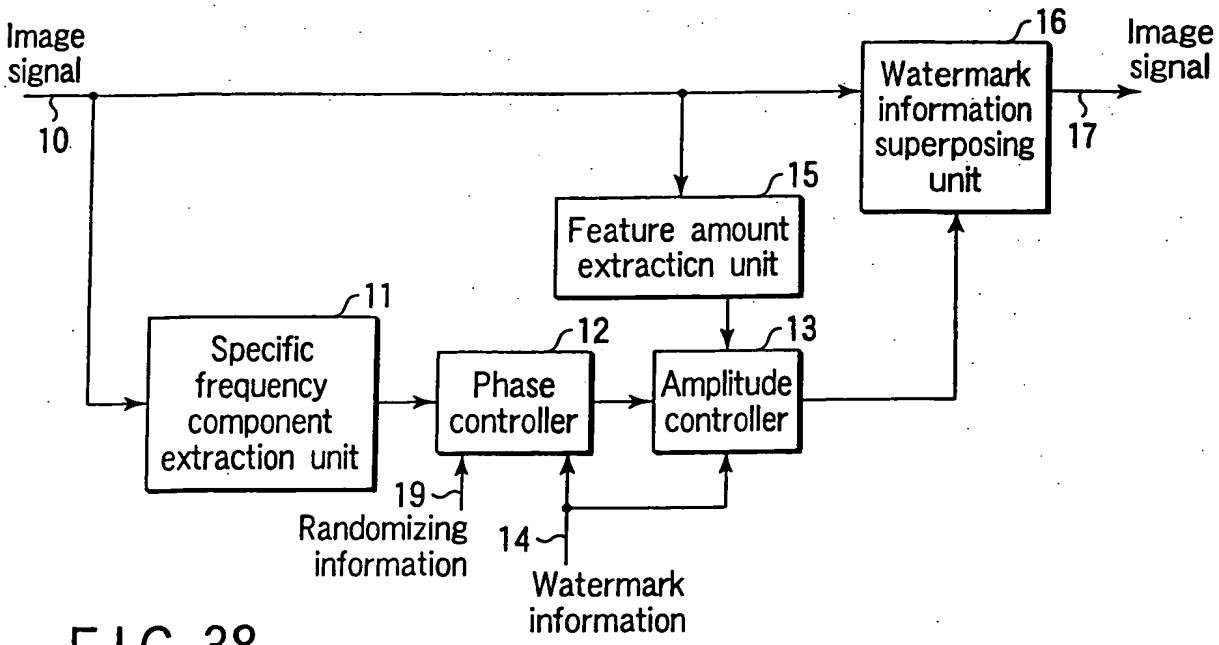

Image signal
10
Watermark information superposing unit
16
Image signal
17
Feature amount extraction unit
15
Specific frequency component extraction unit
11
Phase controller
12
Amplitude controller
13
19
Randomizing information
14
Watermark information

FIG. 38

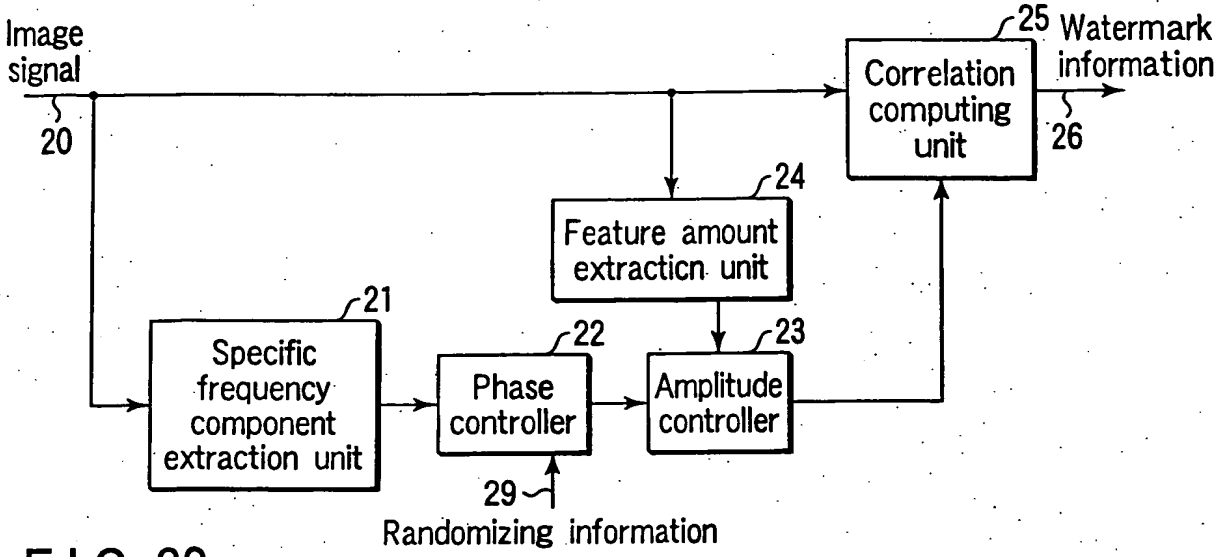


FIG. 39

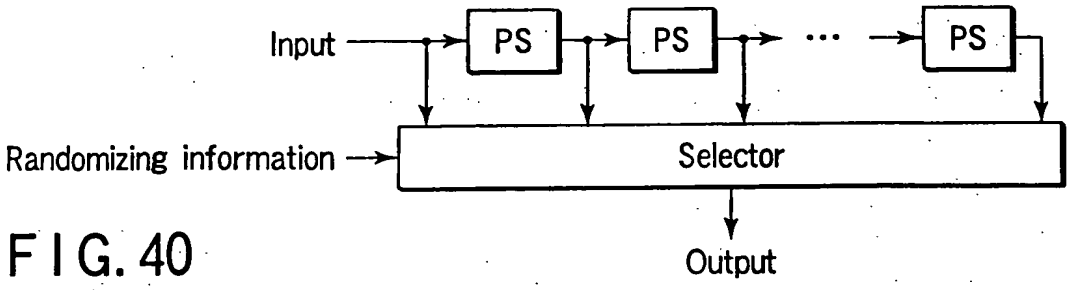


FIG. 40

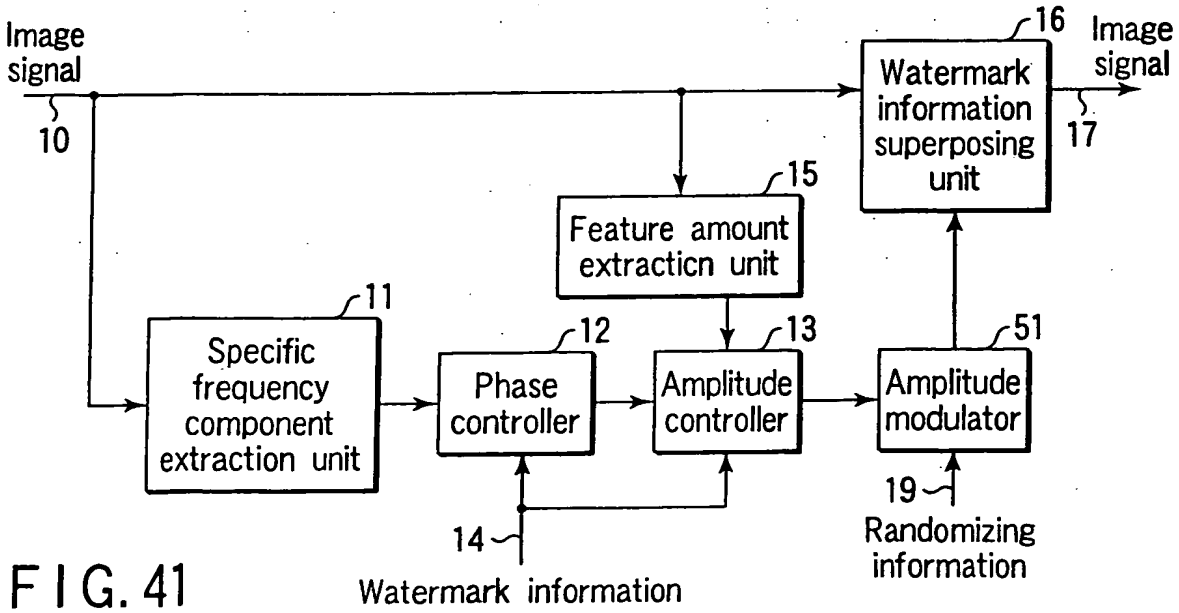


FIG. 41

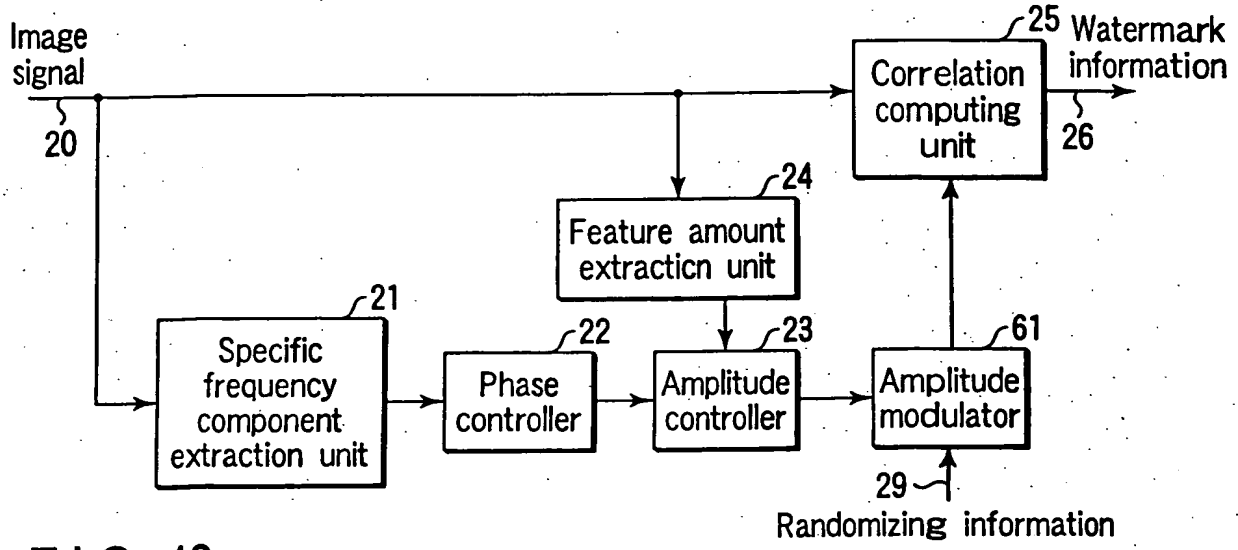

Image signal
20
Specific frequency component extraction unit
21
Phase controller
22
Feature amount extraction unit
24
Amplitude controller
23
Correlation computing unit
25
Watermark information
26
Amplitude modulator
61
29
Randomizing information

FIG. 42

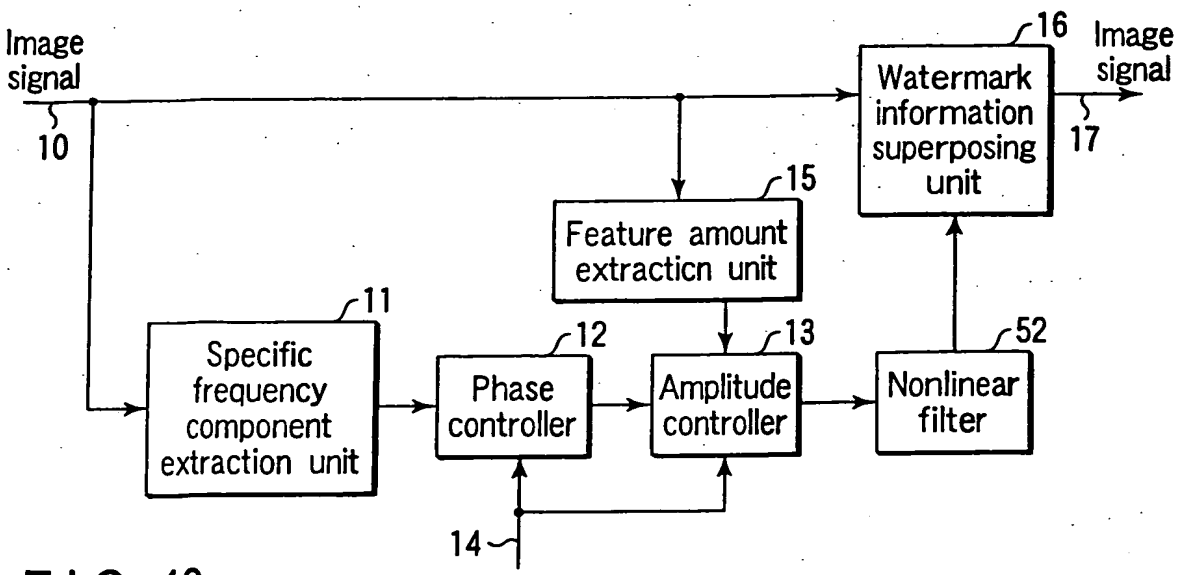

Image signal
10
Specific frequency component extraction unit
11
Phase controller
12
Feature amount extraction unit
15
Amplitude controller
13
Watermark information superposing unit
16
Image signal
17
Nonlinear filter
52
14
Watermark information

FIG. 43

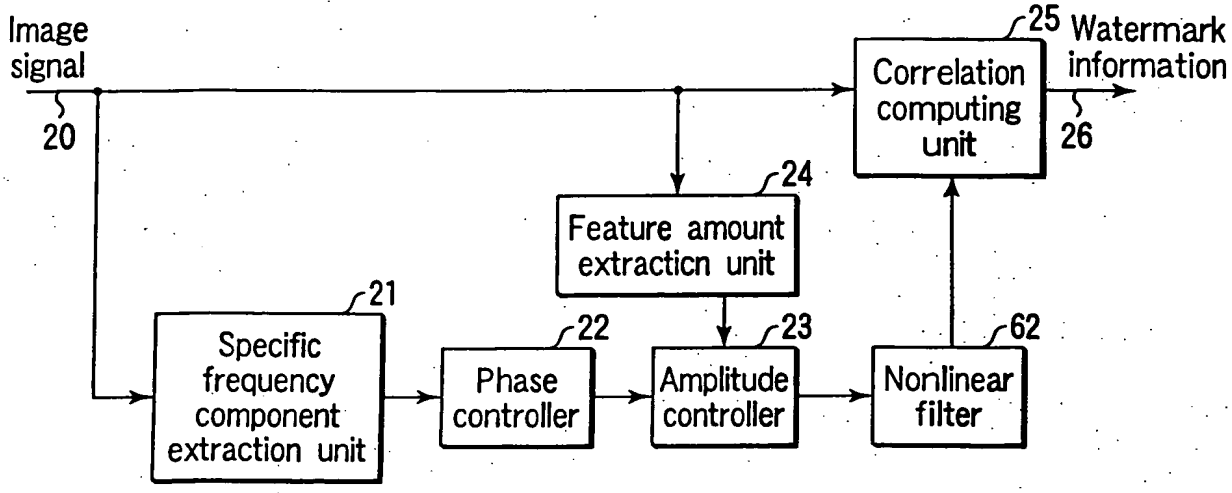


FIG. 44

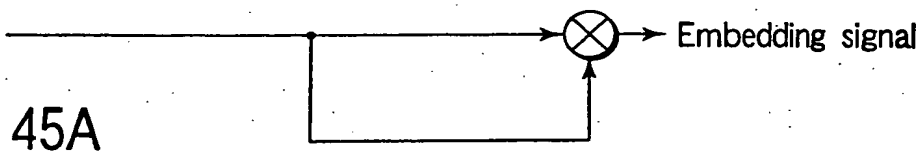


FIG. 45A

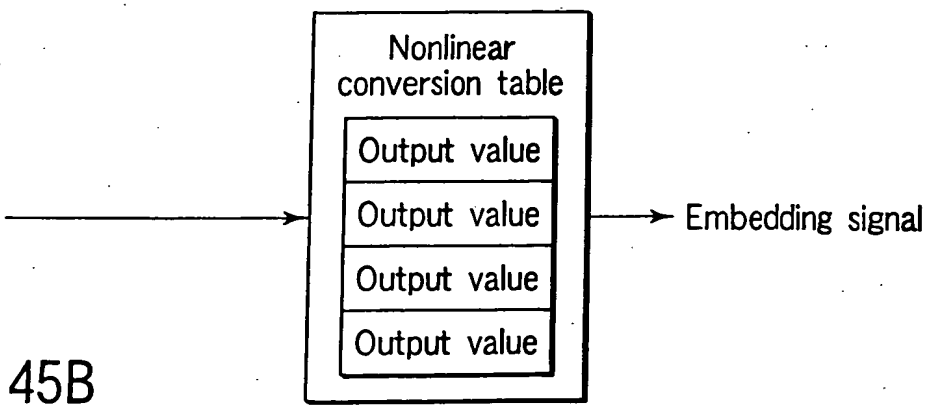


FIG. 45B